

APPENDIX K. GLOSSARY OF KEY TERMS AND CONCEPTS

Adaptive management – a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form, "active" adaptive management employs management programs that are designed to experimentally compare selected policies or practices, by implementing management actions explicitly designed to generate information useful for evaluating alternative hypotheses about the system being managed (<http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Adaptive monitoring design – an iterative process that refines the specifications for monitoring over time as a result of experience in implementing a monitoring program, assessing results, and interacting with users (Ringold et al. 1999)

Advection - the usually horizontal movement of a mass of fluid (as air or an ocean current); also : transport (as of pollutants or plankton) by such movement

Allochthonous. – Foreign in origin. Formed elsewhere than the region found.

Anadromous – (Of fish, e.g. Salmon, Steelhead, Lamprey) Migrating from the ocean up rivers and streams to spawn.

Anthropogenic effects – are caused by or attributed to humans. As used here, they are human influenced factors that cause stress in natural systems.

Aphotic – The depths below the level of light penetration in a water body.

Attributes – any living or nonliving feature or process of the environment that can be measured or estimated and that provide insights into the state of the ecosystem. The term indicator is reserved for a subset of attributes that is particularly information-rich in the sense that their values are somehow indicative of the quality, health, or integrity of the larger ecological system to which they belong (Noon 2003; <http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Autochthonous – Formed in the region where found.

Autogenic – Of or referring to characteristic of organisms that are self-generated.

Benthic – Living at, in, or associated with structures on the bottom of a body of water.

Biological legacies – Anything of biological origin handed down from a predisturbance ecosystem, including trees, wood, surviving propagules and organisms (e.g. buried seeds, seeds stored in serotinous cones, surviving roots and basal buds, mycorrhizal fungi and other soil microbes, invertebrates, and mammals), and soil organic matter.

Biotic integrity – the ability to maintain and support a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region.

Community – is a group of populations of different species occupying a given place at a given time that are viewed as interdependent, an aggregation of interacting species.

Composition – defined as the identity and variety of elements within an ecosystem, including species present and their population structure, abundance, and genetic diversity (Noss 1990).

Degradation – an anthropogenic reduction in the capacity of a particular ecosystem or ecosystem component to perform desired ecosystem functions (e.g., degraded capacity for conserving soil and water resources). Human actions may degrade desired ecosystem functions directly, or they may do so indirectly by damaging the capacity of ecosystem functions to resist or recover from natural disturbances and/or anthropogenic stressors (derived from concepts of Whisenant 1999, Archer and Stokes 2000, and Whitford 2002).

Disturbance – “...any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment” (White and Pickett 1985:7). In relation to monitoring, disturbances are considered to be ecological factors that are within the evolutionary history of the ecosystem (e.g., drought). These are differentiated from anthropogenic factors that are outside the range of disturbances naturally experienced by the ecosystem (Whitford 2002).

Disturbance stimuli – nonlethal, human-caused events that change an animal’s behavior from patterns occurring without human influence; analogous to predation risk (Frid and Dill 2002).

Driver – a natural agent responsible for causing temporal changes or variability in quantitative measures of structural and functional attributes of ecosystems.

Dynamic soil properties – soil properties that vary in relation to management activities, climatic fluctuations, or natural disturbances (e.g., bulk density, infiltration capacity, soil-surface roughness, organic-matter content, soil aggregate stability, biological soil crust cover and composition).

Ecological indicator – see *indicator*.

Ecological integrity – a concept that expresses the degree to which the physical, chemical, and biological components (including composition, structure, and process) of an ecosystem and their relationships are present, functioning, and capable of self-renewal. Ecological integrity implies the presence of appropriate species, populations and communities and the occurrence of ecological processes at appropriate rates and scales as well as the environmental conditions that support these taxa and processes (<http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Ecological sustainability – the tendency of a system or process to be maintained or preserved over time without loss or decline (Dale et al. 2000:642).

Ecoregion – an area over which the climate is sufficiently uniform to permit development of similar ecosystems on sites having similar properties. Ecoregions contain many landscapes with different spatial patterns of ecosystems.

Ecoregions – Large regions which share similar physiography, geology, vegetation and climate.

Ecosystem – a spatially explicit unit of the Earth that includes all of the organisms, along with all components of the abiotic environment within its boundaries (Likens 1992, cited by Christensen et al. 1996:670).

Ecosystem engineers – organisms that directly or indirectly modulate the availability of resources to other species by causing physical state changes in biotic or abiotic materials, thereby modifying, maintaining, and/or creating habitats (Jones et al. 1994).

Ecosystem functioning – the flow of energy and materials through the arrangement of biotic and abiotic components of an ecosystem. Includes many ecosystem processes such as primary production, trophic transfer from plants to animals, nutrient cycling, water dynamics and heat transfer. In a broad sense, ecosystem functioning includes two components: ecosystem resource dynamics and ecosystem stability (Díaz and Cabido 2001).

Ecosystem health – a metaphor pertaining to the assessment and monitoring of ecosystem structure, function, and resilience in relation to the notion of ecosystem “sustainability” (following Rapport 1998 and Costanza et al. 1998). A healthy ecosystem is sustainable (see *Sustainable ecosystem*, below).

Ecosystem integrity – see *ecological integrity*.

Ecosystem management – the process of land-use decision making and land-management practice that takes into account the full suite of organisms and processes that characterize and comprise the ecosystem and is based on the best understanding currently available as to how the ecosystem works. Ecosystem management includes a primary goal of sustainability of ecosystem structure and function, recognition that ecosystems are spatially and temporally dynamic, and acceptance of the dictum that ecosystem function depends on ecosystem structure and diversity (Dale et al. 2000:642).

Ecosystem sustainability – see *sustainable ecosystem*.

Edaphic – Related to or caused by particular soil conditions, as of texture or drainage, rather than by physiographic or climate factors.

Endpoints – Ecosystem attributes of ecological and/or societal importance (Harwell et al. 1999). Endpoints may or may not be indicators of overall ecosystem condition (also referred to as assessment endpoints).

Equilibrium – A condition of balance between two opposing forces.

Fen – A wetland characterized by moving water having low pH (acidic). The fens of the Klamath region are particularly distinctive because they are dominated by the unusual looking, insectivorous pitcher plant (*Darlingtonia californica*).

Focal ecosystems – ecosystems that play significant functional roles in landscapes by their disproportionate contribution to the transfer of matter and energy, or by their disproportionate contribution to landscape-level biodiversity (Miller; adapted from definition of *focal species*).

Focal resources – are park resources that, by virtue of their special protection, public appeal, or other management significance, have paramount importance for monitoring regardless of current threats or whether they would be monitored as an indication of ecosystem integrity. Focal resources might include ecological processes, such as deposition rates of nitrates and sulfates in certain parks; or they may be a species that is harvested, endemic, alien, or has protected status.

Focal species / organisms – species and/or organisms that play significant functional roles in ecological systems by their disproportionate contribution to the transfer of matter and energy, by structuring the environment and creating opportunities for additional species and/or organisms, or by exercising control over competitive dominants and thereby promoting increased biological diversity (derived from Noon 2003:37).
[Encompasses concepts of keystone species, umbrella species, and ecosystem engineers.]

Functional groups – groups of species that have similar effects on ecosystem processes (Chapin et al. 1996) – frequently applied interchangeably with *functional types*.

Fumarole – A hole in or near a volcano from which vapor rises.

Functional types – sets of organisms sharing similar responses to environmental factors such as temperature, resource availability, and disturbance (= functional *response* types) and/or similar effects on ecosystem functions such as productivity, nutrient cycling, flammability, and resistance / resilience (= functional *effect* types) (Díaz and Cabido 2001).

Granodiorite – Granitic like rock containing relatively large amounts of the mineral diorite.

Herpetofauna – Reptiles and amphibians, collectively.

<http://www.epa.gov/emap/html/pubs/docs/resdocs/mglossary.html>). For purposes of monitoring, stressors are considered to be anthropogenic factors that are outside the range of disturbances naturally experienced by the ecosystem (Whitford 2002).

Hydrologic function (lotic and lentic systems) – capacity of an area to: dissipate energies associated with (1) high stream flow (lotic); or (2) wind action, wave action, and overland flow (lentic); thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and groundwater recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; support greater biodiversity (from Prichard et al. 1998, 1999)

Hydrologic function (upland systems) – capacity of a site to capture, store, and safely release water from rainfall, run-on, and snowmelt, to resist a reduction in this capacity, and to recover this capacity following degradation (Pellant et al. 2000).

Indicator (general use of term) – a term reserved for a subset of environmental attributes that is particularly information-rich in the sense that their values are somehow indicative of the quality, health, or integrity of the larger ecological system to which they belong (Noon 2003; <http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Indicators of ecosystem health (specific use of term) – measurable attributes of the environment (biotic or abiotic) that provide insights regarding (1) the functional status of one or more key ecosystem processes, (2) the status of ecosystem properties that are clearly related to these ecosystem processes, and/or (3) the capacity of ecosystem processes or properties to resist or recover from natural disturbances and/or anthropogenic stressors (modified from Whitford 1998). In the context of ecosystem health, key ecosystem processes and properties are those that are most closely associated with the capacity of the ecosystem to maintain its characteristic structural and functional attributes over time (including natural variability).

Inherent soil properties – soil properties that are relatively unaffected by management activities, climatic fluctuations, and natural disturbances (e.g., texture, color, depth, mineralogy, horizonation).

Inventory – is an extensive point-in-time effort to determine location or condition of a resource, including the presence, class, distribution, and status of plants, animals, and abiotic components such as water, soils, landforms, and climate.

Karst – An area of limestone formations characterized by sinks, ravines, and underground streams.

Landscape – a spatially structured mosaic of different types of ecosystems interconnected by flows of materials (e.g., water, sediments), energy, and organisms.

Landscape diversity – the number of ecosystem types and their spatial distribution (Chapin et al. 1998).

Landscape ecology – the study of structure (including abundance and distribution of organisms), function, and change in a heterogeneous land area composed of interacting ecosystems.

Lentic – Referring to standing freshwater habitats, such as ponds and lakes.

Limnetic – Pertaining to or living in the open water of a freshwater pond or lake.

Littoral – Referring to the marginal zone of the sea: intertidal. In fresh water, the shallow zone that may contain rooted plants.

Lotic – Referring to running freshwater habitats.

Measures – the specific variables used to quantify the condition or state of an attribute or indicator (or vital sign). These are specified in definitive sampling protocols. For example, stream acidity may be the indicator, while pH units are the measure (from NPS Inventory and Monitoring website, <http://science.nature.nps.gov/im/monitor/vsm.htm#Definitions>).

Mesic – Of or pertaining to a relatively moist and benign environment.

Metamorphic – Geologic parent material that has been changed from its original form under intense heating and pressure.

Monitoring – is the systematic, consistent, and simultaneous measurements of physical, chemical, biological, and human-use variables of different landscape compartments, through time and at specified locations. In theory, by monitoring a wide range of variables at long-term sites, it is possible to gain an understanding of how ecosystems function and respond to change.

Natural variability – the ecological conditions, and the spatial and temporal variation in these conditions, that are relatively unaffected by people, within a period of time and geographical area appropriate to an expressed goal (Landres et al. 1999).

Neoendemic – An endemic (taxon restricted to a specific geographic area) that evolved in recent evolutionary history. Compare with paleoendemic.

Nonequilibrium – Characterized by constant change (see equilibrium).

Paleoendemic – An endemic (taxon restricted to a specific geographic area) that evolved in the relatively distant past (e.g. Tertiary). Compare with neoendemic.

Pelagic – Occurring in or over open water and away from the bottom.

Peridotite – A granite like rock type without the mineral feldspar and with large amounts of the mineral olivine.

Photic – The zone or depth in a body of water into which light can penetrate.

Reference conditions – the range of historic (or natural) variability in ecological structures and processes, reflecting recent evolutionary history and the dynamic interplay of biotic and abiotic conditions and disturbance patterns (Morgan et al 1994; Swanson et al. 1994).

Research – the objective of understanding ecological processes and, in some cases, determining the cause of changes observed by monitoring.

Resilience – the capacity of a particular ecological attribute or process to recover to its former reference state or dynamic after exposure to a temporary disturbance and/or stressor (adapted from Grimm and Wissel 1997). The ability of a natural ecosystem to restore its structure following acute or chronic disturbance (Westman 1978). Resilience is a dynamic property that varies in relation to environmental conditions (Scheffer et al. 2001).

Resistance – the capacity of a particular ecological attribute or process to remain essentially unchanged from its reference state or dynamic despite exposure to a disturbance and/or stressor (adapted from Grimm and Wissel 1997). Resistance is a dynamic property that varies in relation to environmental conditions (Scheffer et al. 2001).

Soil / site stability – the capacity of a site to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water (Pellant et al. 2000).

Soil degradation – a decline in soil quality (i.e., decline in a soil's capacity to perform desired ecological functions)

Soil quality – the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation (Karlen et al. 1997:6). From an NPS perspective, soil quality is defined by a soil's capacity to perform the following ecological functions: (a) regulate hydrologic processes; (b) capture, retain, and cycle mineral nutrients; (c) support characteristic native communities of plants and animals. Soil quality can be regarded as having (1) an inherent component defined by the soil's inherent soil properties as determined by the five factors of soil formation, and (2) a dynamic component defined by the change in soil function that is influenced by human use and management of the soil (Seybold et al. 1999).

Soil resilience – the capacity of a soil to recover its functional and structural integrity after a disturbance, as characterized by two components: (1) the rate of recovery and (2) the degree of recovery (Herrick and Wander 1998, Seybold et al. 1999). For a particular

soil, resilience depends on the spatial scale of the disturbance and the temporal scale of evaluation, and it must be described with respect to the type and degree of disturbance (Seybold et al. 1999). In general, soil resilience is inversely related to climatic aridity.

Soil resistance – the capacity of a soil to continue to function without change through a disturbance (Herrick and Wander 1998, Seybold et al. 1999). For a particular soil, resistance must be defined in relation to a particular type and degree of disturbance (Seybold et al. 1999).

State – as applied to state-and-transition models, a *state* is defined as “a recognizable, resistant and resilient complex of two components, the soil [or geomorphic] base and the vegetation structure” (Stringham et al. 2003:109). These two ecosystem components interactively determine the functional status of the primary ecosystem processes of energy flow, nutrient cycling, and hydrology. States are dynamic and “... are distinguished from other states by relatively large differences in plant functional groups and ecosystem processes [including disturbance and hydrologic regimes] and, consequently, in vegetation structure, biodiversity, and management requirements” (Bestelmeyer et al. 2003:116). (Also see *threshold* and *transition*.)

Stressor: any physical, chemical, or biological entity or process that can induce an adverse response (modified from EMAP Master Glossary,

Structure – the spatial organization of the constituent parts of the ecosystem, including large-scale patterns.

Sustainable ecosystem – an ecosystem “...that, over the normal cycle of disturbance events, maintains its characteristic diversity of major functional groups, productivity, and rates of biogeochemical cycling” (Chapin et al. 1996:1016).

Threshold – as applied to state-and-transition models, a *threshold* is a point “...in space and time at which one or more of the primary ecological processes responsible for maintaining the sustained [dynamic] equilibrium of the state degrades beyond the point of self-repair. These processes must be actively restored before the return to the previous state is possible. In the absence of active restoration, a new state is formed” (Stringham et al. 2003:109). Thresholds are defined in terms of the functional status of key ecosystem processes and are crossed when capacities for resistance and resilience are exceeded. (Also see *state* and *transition*.)

Transition – as applied to state-and-transition models, a *transition* is a trajectory of change that is precipitated by natural events and/or management actions which degrade the integrity of one or more of the primary ecological processes responsible for maintaining the dynamic equilibrium of the state. Transitions are vectors of system change that will lead to a new state without abatement of the stressor(s) and/or disturbance(s) prior to exceeding the system’s capacities for resistance and resilience (adapted from Stringham et al. 2003). (Also see *state* and *threshold*.)

Trend – a unidirectional change.

Variable – any quantitative aspect of an object of concern.

Vital signs – a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values. The elements and processes that are monitored are a subset of the total suite of natural resources that park managers are directed to preserve "unimpaired for future generations," including water, air, geological resources, plants and animals, and the various ecological, biological, and physical processes that act on those resources. Vital signs may occur at any level of organization including landscape, community, population, or genetic level, and may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes) (from NPS Inventory and Monitoring website, <http://science.nature.nps.gov/im/monitor/vsm.htm#Definitions>).

Xeric – Of or pertaining to a relatively dry, often stressful environment.

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